Claims 1-18 are presented for consideration. Claims 1, 3, 5, 6 and 12 are independent.

Applicant notes that the Examiner has made final the restriction requirement previously set forth. Claims 3, 4, 12-14, 16 and 17, having been withdrawn from consideration, have been retained in this application in order to preserve Applicant's rights. Applicant requests that the Examiner contact his undersigned representative should it be necessary to cancel these claims to advance the subject application to issue.

Claims 1, 2, 5-11 and 15 have been amended to clarify features of the subject invention, while claim 18 has been added to recite additional features of the subject invention. Support for these changes can be found in the original application, as filed. Therefore, no new matter has been added.

Applicant requests favorable reconsideration and withdrawal of the rejections set forth in the above-noted Office Action.

Claims 7 and 10 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. The Examiner objected to a recitation in claim 7. To expedite prosecution, this claim has been amended in light of the Examiner's comments. Applicant submits that these changes overcome this rejection. Such favorable indication is requested.

Turning now to the art rejection, claims 1, 2, 5-11 and 15 were rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 5,591,958 to Nishi et al. Applicant submits that this patent does not teach many features of the present invention, as recited in independent claims 1, 5 and 6. Therefore, this rejection is respectfully traversed.

In one aspect of the invention, independent claim 1 recites a scan type exposure apparatus wherein a pattern of an original is lithographically transferred to a substrate sequentially while the original and the substrate are scanningly moved relative to exposure light. The apparatus includes a photodetector, disposed at a position optically conjugate with the original, for detecting information regarding the original and for producing an output, storing means for storing correction information with respect to the output of the photodetector in relation to different positions of the original to be illuminated with the exposure light and a correction device for receiving correction information stored in the storage means and correcting, in the lithographic pattern transfer, the output of the photodetector by use of the stored correction information.

In yet another aspect of the invention, independent claim 5 recites an exposure apparatus for lithographically transferring a pattern of an original onto a substrate. The apparatus includes, among other features, first and second photodetectors, storing means for storing correction information with respect to an output of the first photodetector in relation to different positions of the original, on the basis of the outputs of the two photodetectors, and a correction device for receiving the correction information stored in the storing means and for correcting, in the lithographic pattern transfer, the output of the first photodetector by use of the correction information.

In yet another aspect of the invention, independent claim 6 recites an exposure apparatus that includes, among other features, a photodetector disposed at a position optically conjugate with the original, for detecting information regarding the original and for producing an output,

control means for controlling the exposure light output from the light source on the basis of the output of the photodetector and correcting means for reducing an influence of reflection light from the original, on the basis of the output of the photodetector as the original is illuminated by the illumination optical system.

The present invention is suitably applicable to a scan type exposure apparatus in which a slit-like illumination region is defined on an original. The original can be scanned with this slit-like illumination region, by which a very fine pattern formed on the original can be lithographically transferred onto a substrate, such as a wafer, through a projection optical system.

Generally speaking, when an original is illuminated with light from an illumination optical system, for example, a small quantity of light may be reflected from the original back into the illumination optical system. The thus reflected light quantity may be directed also to an illumination light detector, which may be provided inside the illumination optical system. In that situation, the light quantity will be measured as external disturbance light with respect to measurement of the illumination light quantity. If this occurs, exposure control precision is degraded.

The external disturbance light discussed above is dependent upon the shape of the pattern formed on the original. Thus, when the original is scanned with a slit-like illumination region, for example, the reflected light quantity changes as the illuminated position upon the original displaces with the scan. In accordance with the present invention, to address this situation, reflection only with regard to the slit-like illumination region needs to be measured, and based on this, the slit illumination light quantity measurement can be corrected.

Thus, when the present invention is applied to a scan type exposure apparatus, a projection lens and an illumination optical system may be so interrelated to provide Koehler illumination. Further, in order to enable measurement of reflected light only from a slit-like illumination region, a structure of a critical illumination system may be adopted in which the detector is disposed at a position conjugate with the original.

With such an arrangement, regardless of the position of a slit-like illumination region upon an original, a reflection light quantity from the original can be measured accurately at any time. Accordingly, the present invention enables accurate and sequential exposure amount control.

Applicant submits that the cited art does not teach or suggest such features of the present invention, as recited in independent claims 1, 5 and 6.

The Nishi et al. patent is directed to a scan type exposure apparatus have a die-by-die exposure function. The exposure amount is controlled on the basis of output signals from an irradiation amount monitor 58 on a wafer stage, an integrator sensor 46 and a reflectivity monitor 54. Using an output signal of the irradiation amount monitor 58 as a reference, in that patent, the reflectivity monitor 64 and the integration sensor 84 can be calibrated. Then, the integrated exposure amount with respect to the entire reticle surface can be calculated, and thermal changes in optical characteristics of the projection lens due to absorption of light (that is, errors in projection magnification or focus position) are corrected. For correction of these errors, the Nishi et al. patent refers to measurement of light absorption efficiency of the projection lens and to various correction methods.

In the Nishi et al. patent, however, in order to achieve accurate measurement of the exposure amount throughout the entire projection exposure region, the integrated exposure amount of that whole region on an original side and a wafer side is measured in advance. The measurement results are then reflected to the exposure amount control during the actual wafer exposure.

Accordingly, in the Nishi et al. patent, at each of the reticle position and wafer position, the quantity of reflected light, at the entire exposure region on the projected image plane must be measured. Accordingly, that patent uses an arrangement of a Koehler illumination system and a reflectivity monitor for measuring the reflected light quantity from the reticle (original) which is provided at a position which is optically conjugate with the pupil of the projection lens.

In general terms, the present invention, recited in independent claims 1, 5 and 6, and the arrangement in the Nishi et al. patent might be similar with respect to measuring the quantity of reflection light from the original. In the present invention, however, the information related to the reflected light quantity from a local slit-like exposure region on an original should be detected. To this end, in the present invention, an arrangement of a critical illumination system is typically applied in which a photodetector for measuring the quantity of reflected light can be provided at a position optically conjugate with the original. To the contrary, in the Nishi et al. patent, information related to the reflection must be obtained with regard to the entire exposure region on the original (reticle) and, to this end, a structure of Koehler illumination is used. That is, a detector for detecting a quantity of reflected light is provided at a position optically

conjugate with the pupil plane of the projection lens. This is in marked contrast to the present invention.

For the reasons discussed above, Applicant submits that the Nishi et al. patent does not teach or suggest the salient features of Applicant's present invention, as recited in independent claims 1, 5 and 6, in which a photodetector is arranged at a particular position, correction information with respect to an output of a photodetector is stored, and, in the lithographic pattern transfer, the output of the photodetector can be corrected on the basis of the correction information.

For the foregoing reasons, Applicant submits that the present invention, as recited in independent claims 1, 5 and 6, is patentably defined over the cited art.

Dependent 2, 7-11, 15 and 18 also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Further individual consideration of these dependent claims is requested.

Applicant further submits that the instant application is in condition for allowance. Favorable reconsideration, withdrawal of the rejections set forth in the above-noted Office Action and an early Notice of Allowance are requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address listed below.

Respectfully submitted,

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APPENDIX A

IN THE SPECIFICATION

Please substitute the paragraph beginning at page 2, line 7, with the following.

-- In such semiconductor exposure apparatuses, in order to maintain constant the [the] integrated exposure amount of a wafer as determined by the image plane illuminance and the scan speed, the image plane illuminance has to be kept constant. In order to meet such a requirement, in conventional scan type semiconductor exposure apparatuses, a photodetector is disposed at a position in an illumination system which is optically conjugate with the reticle, and an applied electric power to a discharge lamp is controlled so that an output of the photodetector becomes constant. --

Please substitute the paragraph beginning at page 2, line 19, with the following.

-- Such a technique, however, involves a problem that, even if the control is made to keep the output of the photodetector constant, the integrated exposure amount of a wafer [can not] cannot be made constant. --

Please substitute the paragraph beginning at page 8, line11, and ending on page 9, line 1, with the following.

-- Alternatively, as a preparation, while an applied electric power to the discharge lamp may be kept constant and while the scan motion may be performed at a speed lower than an ordinary scan speed, outputs of the photodetector and detection results of reflection light detecting means, for detecting reflection light from the pattern surface of the original, may be obtained in relation to each of the movement positions [are] obtained. In an actual exposure process of the substrate, at each of the movement positions in the scan motion, any influence of reflection light may be removed or reduced on the basis of an output of the photodetector and a result of detection by the reflection light detecting means. Also, the output of the light source may be controlled on the basis of an output of the photodetector with the influence of reflection light being removed or reduced. --

Please substitute the paragraph beginning at page 16, line 16, with the following.

-- Figure 3 shows details of the variable slit portion 43. Denoted in the drawing at 100a - 100k and 101a - 101k are upper slit plates and lower slit plates which are movable in directions depicted by an arrow 129. Denoted at 102a - 102k and 103a - 103k are guides for these slit plates. Denoted at 104a - 104k and 105a - 105k are rotatable protrusions which are movable integrally with the slit plates. Denoted at 106 and 107 are spring plates extending through the rotatable protrusions to connect the slits to each other. Denoted at 110 - 113 and 120 - 123 are motors for driving particular slit plates. --

Please substitute the paragraph beginning at page 17, line 9, with the following.

-- Figure 5 shows the spectral reflectivity of the elliptical mirror 3. The elliptical mirror 3 has such a characteristic that only light of about 320 - 400 nm is reflected thereby. --

Please substitute the paragraph beginning at page 17, line 13, with the following.

-- In Figure 6, the broken line and the solid line depict the interception characteristics of the middle-band i-line filter 6 and the narrow-band i-line filter 32, respectively. The interception characteristic of the middle-band i-line filter 6 is equivalent to that of the narrow-band i-line filter 32 when the same is expanded by a few tens of nm. --

Please substitute the paragraph beginning at page 24, line 13, with the following.

-- Like a conventional constant-illuminance mode, an image plane illuminance is specified. However, since the applied electric power to the i-line lamp 1 is controlled so that the illuminance becomes constant, the purity will change. The timing for changing the applied electric power can be specified in relation to each [wafers] wafer or each [jobs] job. --

Please substitute the paragraph beginning at page 24, line 21, with the following.

-- This is a mode added in the semiconductor exposure apparatus of this embodiment. The purity of the i-line lamp 1 is specified. The applied electric power is controlled on the basis of the purity measurement, to maintain the specified purity. The timing for changing the applied electric power can be specified in relation to each [wafers] wafer or each [jobs] job. --

Please substitute the paragraph beginning at page 26, line 6, with the following.

-- The semiconductor exposure apparatus of this embodiment has an exposure shutter protecting function, as has been described with reference to "(C) Improving the durability of the narrow-band i-line filter and the high-speed exposure shutter:". However, the protection is not complete, because there is a possibility that [any] impurities are mixed into a cooling air for the shutter blade 80, which impurities may be deposited on the surface of the shutter blade 80 to cause a decrease of the surface reflectivity of the shutter blade 80 and an increase of thermal absorption. --

Please substitute the paragraph beginning at page 26, line 18, and ending on page 27, line 15, with the following.

-- In consideration of it, the semiconductor exposure apparatus of this embodiment is provided with a broad-band detector 23, for directly detecting a wavelength in the same bandwidth region as the light to be collected by the elliptical mirror 3, as well as a photodetector 24 for detecting reflection light from the shutter blade 80. Through the operation of the CPU (not shown) inside the illumination system control 71, after the i-line lamp 1 is turned on and after the discharge of the i-line lamp becomes stable, and when the blocking plate 4 [are] <u>is</u> in its open state, analog signal outputs of the respective detectors are picked up at intervals of a few mSec. These signals are then digitalized by an A/D converter (not shown), and thereafter calculation of a ratio of measurement data of the detectors, that is, calculation of the surface reflectivity of the shutter blade 80, is performed. If the result of surface reflectivity calculation is

beyond a tolerable range met with respect to a value, an i-line lamp 1 extinction signal is promptly supplied to the lighting device 2. Also, this disorder is signaled to the general control 72. In response to reception of that signal, the general control 72 stops the operation of the apparatus, and presents an alarm and display. --

Please substitute the paragraph beginning at page 28, line 26, and ending on page 29, line 9, with the following.

-- The semiconductor exposure apparatus of this embodiment has a function for reducing astigmatism of a projection lens, to be produced during the exposure process. In this embodiment, at the stage of projection lens designing, a slit shape [and] as well as an illuminance distribution inside a slit effective to minimize the production of astigmatism due to execution of the exposure process are determined in relation to each of the illumination modes, and they are reproduced and accomplished in the semiconductor exposure apparatus. --

Please substitute the paragraph beginning at page 29, line 10, with the following.

-- Figure 9A shows an example of a slit shape and an illuminance distribution inside a slit, in a conventional semiconductor exposure apparatus. As seen from the drawing, generally in conventional semiconductor exposure apparatuses, the same illuminance distribution in the scan direction is defined at every [points] point on the slit. Namely, substantially the same shape is defined at Sa, Sb and Sc in Figure 9A. This is to accomplish uniformness of integrated exposure amount in the slit direction. --

Please substitute the paragraph beginning at page 29, line 20, with the following.

-- Further, in some conventional semiconductor exposure apparatuses, the slit width at each [points] point on the slit is made variable so that the same illuminance integrated amount can be provided in the scan direction. This is to accomplish uniformness of integrated exposure amount in the slit direction. [In] On that occasion, substantially the same area is defined at Sa, Sb and Sc in Figure 9A. --

Please substitute the paragraph beginning at page 31, line 14, and ending on page 32, line 2, with the following.

-- In the semiconductor exposure apparatus of this embodiment, when a reticle 50 is placed on the reticle stage 52 the first time, the reticle average diffraction rate and the reticle transmissivity are measured. This measurement is performed under the same illumination mode as the practical exposure process (the same stop 35 in the actual exposure). Here, the reticle diffraction sensor 66 of Figure 7 is held stationary at about a central position in the exposure light flux, and it operates to perform integrated measurement of the light energy impinging thereon during the scan motion of the reticle 50. From the ratio in integration measurement value among the sensors 132 - 136 of the reticle diffraction sensor 66, the average diffraction rate being set is calculated. --

Please substitute the paragraph beginning at page 34, line 18, with the following.

-- As a matter of course, for <u>making</u> [uniforming] <u>uniform</u> the integrated exposure amount along the scan direction, the light energy distribution in the scan direction thus accomplished provides the same value at any slit position, when integrated in the scan direction. --

Please substitute the paragraph beginning at page 36, line 18, with the following.

-- (3) The reticle stage 52 is scanningly moved through the whole exposure region, at a speed sufficiently slower than that in an ordinary exposure process. The measured values of the reticle surface illuminance detector 39 at each reticle [positions,] <u>position</u> are stored into a memory inside the illumination system control 71. --

Please substitute the paragraph beginning at page 39, line 12, with the following.

-- (1) A method based on "correction with the reticle reflection light detector 41" [has] has been described in the introductory part of the specification. --

Please substitute the paragraph beginning at page 39, line 16, with the following.

-- (2) If the reticle transmissivity is high and the wafer reflectivity is high, there may be cases in which the influence of reflection light from a wafer appears on the reticle surface illuminance detector 39. [In] <u>On</u> that occasion, the method described with reference to the above embodiment may be done similarly, while a reflection plate having substantially the same reflection factor as <u>that</u> of an actual wafer is disposed at the wafer position. --

Please substitute the paragraph beginning at page 40, line 8, with the following.

-- Figure 11 is a flow chart of <u>a</u> procedure for <u>the</u> manufacture of microdevices such as semiconductor chips (e.g., ICs or LSIs), liquid crystals panels, or CCDs, for example. --

Please substitute the paragraph beginning at page 40, line 12, and ending on page 41, line 2, with the following.

-- Step 1 is a design process for designing a circuit of a semiconductor device. Step 2 is a process for making a mask on the basis of the circuit pattern design. Step 3 is a process for preparing a wafer by using a material such as silicon. Step 4 is a wafer process (called a pre-process) wherein, by using the so prepared mask and wafer, circuits are practically formed on the wafer through lithography. Step 5 subsequent to this is an assembling step (called a post-process) wherein the wafer having been processed by step 4 is formed into semiconductor chips. This step includes an assembling (dicing and bonding) process and a packaging (chip sealing) process. Step 6 is an inspection step wherein <u>an</u> operation check, <u>a</u> durability check and so on for the semiconductor devices provided by step 5, are carried out. With these processes, semiconductor devices are completed and they are shipped (step 7). --

<u>IN THE CLAIMS</u>

1. (Amended) A scan type exposure apparatus wherein a pattern of an original is lithographically transferred to a substrate sequentially while the original and the substrate are scanningly moved relative to exposure light, said apparatus comprising:

a photodetector, disposed at a position optically conjugate with the original, for detecting information regarding the original and for producing an output; [and]

storing means for storing correction information with respect to [an] the output of said photodetector, in relation to different positions of the original to be illuminated with the exposure light[, such that,]; and

a correction device for receiving correction information stored in said storage means and correcting, in the lithographic pattern transfer, the output of said photodetector [can be corrected] by use of the stored correction information.

2. (Amended) An apparatus according to Claim 1, wherein the correction information concerns information corresponding to a light quantity of reflection light at each of different positions of the original illuminated with the exposure light.

5. (Amended) An exposure apparatus for lithographically transferring a pattern of an original onto a substrate, said apparatus comprising:

a first photodetector, disposed at a position optically conjugate with the original, for detecting information regarding the original and for producing an output;

a second photodetector for detecting reflection light from the original and for producing an output; and

storing means for storing correction information with respect to [an] the output of said first photodetector in relation to different positions of the original, on the basis of the outputs of said first and second photodetectors[, such that,]; and

a correction device receiving the correction information stored in said storing means and for correcting, in the lithographic pattern transfer, the output of said first photodetector [can be corrected] by use of the correction information.

6. (Amended) An exposure apparatus, comprising:

an illumination optical system for illuminating an original with exposure light output from a light source;

a projection optical system for projecting a pattern of the original, illuminated by the illumination optical system, onto a substrate;

a photodetector, disposed at a position optically conjugate with the original, for detecting information regarding the original and for producing an output;

control means for controlling the exposure light output from [an output of] the light source on the basis of [an] the output of the photodetector; and

correcting means for reducing an influence of reflection light from the original, on the basis of [an] the output of the photodetector as the original is illuminated by the illumination optical system.

7. (Amended) An apparatus according to Claim 6, wherein said correcting means operates to reduce or remove the influence of the reflection light, while referring to [an] the output of said photodetector in a state in which the original is illuminated by said illumination optical system and in which there is no reflection light coming from [the pattern surface of] the original and directed back to said photodetector.

8. (Amended) An apparatus according to Claim 6, wherein said correcting means includes reflection light detecting means for detecting [any] reflection light from the original, as illuminated by said illumination optical system, and being directed back to said illumination optical system, and wherein said correcting means operates to reduce or remove the influence of the reflection light, while referring to a result of the detection by said reflection light detecting means.

9. (Amended) An apparatus according to Claim 6, wherein said exposure apparatus is a scan type exposure apparatus in which exposure is performed while the original and the substrate are scanningly moved relative to the [illumination] exposure light from said illumination optical system and relative to said projection optical system, wherein said correcting means is operable to reduce or remove any influence of the reflection light at each movement [positions] position in the scan motion, and [wherein]said control means is operable to control the exposure light output from [an output of] said light source on the basis of [an] the output of said photodetector, with

the influence of the reflection light at each of the movement positions in the scan motion being reduced or removed.

10. (Amended) An apparatus according to Claim 7, wherein said exposure apparatus is a scan type exposure apparatus in which exposure is performed while the original and the substrate are scanningly moved relative to the [illumination] exposure light from said illumination optical system and relative to said projection optical system, wherein said light source comprises a discharge lamp, [wherein] said correcting means operates so that (i) outputs of said photodetector in relation to each movement [positions] position are obtained beforehand while an applied electric power to said discharge lamp [are] is kept constant and while the scan motion is performed at a speed lower than an ordinary scan speed, (ii) during the [above] procedure in (i), [an] the output of said photodetector in a state in which there is no light coming from the original and directed to said photodetector is obtained, (iii) an actual exposure of the substrate, at a start of the scan motion, an output of said photodetector in a state in which there is no reflection light coming from the original and directed back to said photodetector is obtained, and (iv) at each of the movement positions in the scan motion, any influence of reflection light is removed or reduced on the basis of the [above] output in (iv) and the outputs having been obtained beforehand, and [wherein] said control means controls, at each of the movement positions in the scan motion, the [output of] exposure light output from said light source on the basis of an output of said photodetector with the influence of reflection light being removed or reduced.

11. (Amended) An apparatus according to Claim 8, wherein said exposure apparatus is a scan type exposure apparatus in which exposure is performed while the original and the substrate are scanningly moved relative to the [illumination] exposure light from said illumination optical system and relative to said projection optical system, wherein said light source comprises a discharge lamp, [wherein] said correcting means operates so that (i) outputs of said photodetector and outputs of said reflection light detecting means in relation to each movement [positions] position are obtained beforehand while an applied electric power to said discharge lamp [are] is kept constant and while the scan motion is performed at a speed lower than an ordinary scan speed, and (ii) in actual exposure of the substrate, at each of the movement positions in the scan motion, any influence of reflection light is removed or reduced on the basis of [an] the output of said photodetector and a result of detection by said reflection light detecting means, and [wherein] said control means controls, at each of the movement positions in the scan motion, the output of said light source on the basis of an output of said photodetector with the influence of reflection light being removed or reduced.

15. (Amended) An apparatus according to Claim 2 [or 5], wherein the correction information includes information corresponding to the light quantity of reflection light from the substrate.

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